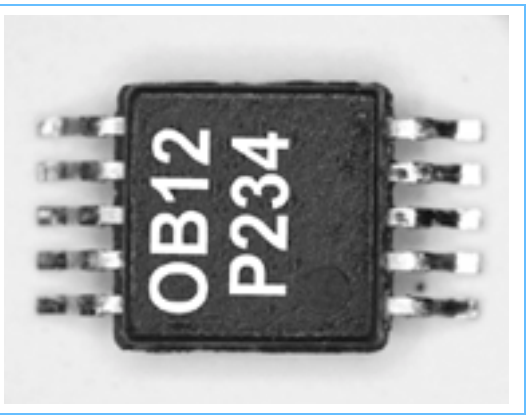
Tri-Band GSM Low Noise Amplifier

Features

- IBM's Silicon Germanium BiCMOS technology
- Receive operation in the GSM900, DCS1800, PCS1900 bands
- Excellent noise figure:
  - 1.4dB over GSM band
  - 1.5dB over DCS band
  - 1.9dB over PCS band
- Low power supply current drain:
  - 5mA high gain mode
  - 3mA low gain mode
  - 1µA standby mode
- High input IP3
- 34dB Typical reverse isolation
- On-chip output match for GSM900 band
- Integrated mode select and bias circuits
- 10-lead MSOP plastic package
- Single-ended interface to inputs and outputs
- Requires single 3-volt power supply

Applications

- Receiver designs for single, dual, or triple mode handsets operating in the GSM900, DCS1800, and PCS1900 bands
- GPS and Bluetooth portable radios

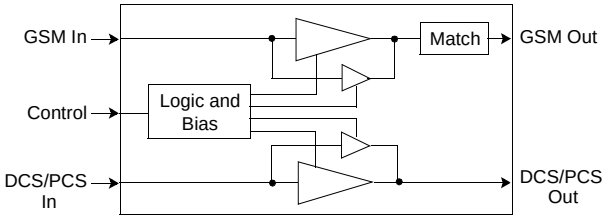


MSOP10L Package
4.9mm x 3.0mm x 0.92mm

Description

The IBM3604011S010 GSM Low Noise Amplifier (LNA) is a monolithic device intended for wireless handset receiver applications in the GSM900, DCS1800, and PCS1900 bands. The LNA is fabricated using IBM's SiGe (silicon-germanium) BiCMOS technology for low noise, high gain, and high third-order intercept point (IP3) performance. The LNA design minimizes the number of external components required for 50-ohm input and output matching.

Figure 1. Block Diagram



Note: The LNA is susceptible to damage from electrostatic discharge (ESD). Observe normal ESD precautions at all times when handling or using the device.

As shown in Figure 1, the LNA consists of the following:

- Two sets of high/low gain blocks
- Decode logic and bias control circuits
- 50-ohm output matching for the GSM900 band

One gain block set is optimized for the GSM900 band, and the other for the DCS1800/PCS1900 bands. The decode logic and bias control circuits facilitate mode control. The band select input switches between the GSM and DCS/PCS bands. A gain control function selects high or low gain for improved dynamic range and reduced current drain. A power down mode extends battery life. The device is housed in a 10-lead MSOP package with an exposed paddle conductor for RF ground.

Ordering Information

www.ibm.com/chips/support/howtobuy.html

Part Number	Description
IBM3604011S010	GSM Tri-Band Low Noise Amplifier
IBM3604011EVBA	Demonstration Board Assembly

Input and Output

Figure 2. Pinout

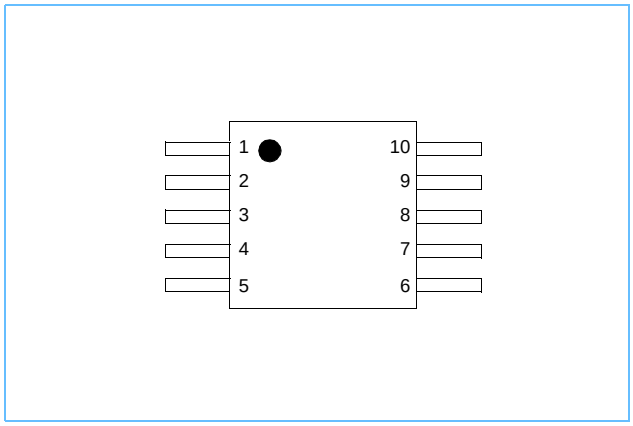
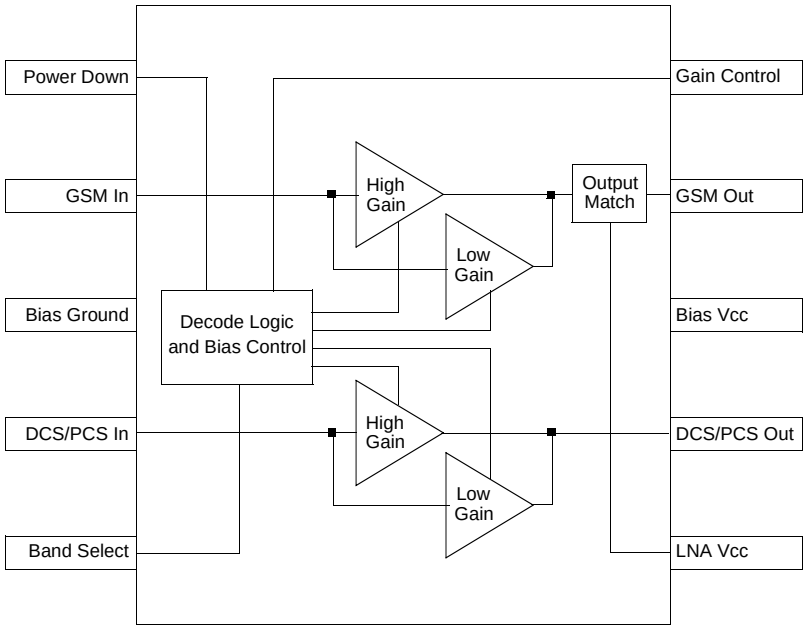


Table 1. Pin Assignments

Pin	Signal	Type	Description
1	Power Down	Input	Power down logic input
2	GSM In	Input	GSM band LNA input
3	Bias Ground	Ground	Bias circuits ground
4	DCS/PCS In	Input	PCS/DCS band LNA input
5	Band Select	Input	Band select logic input
6	LNA Vcc	Power	Positive supply, LNA circuits
7	DCS/PCS Out	Output	PCS/DCS band LNA output
8	Bias Vcc	Power	Positive supply, bias circuits
9	GSM Out	Output	GSM band LNA output
10	Gain Control	Input	Gain control logic, all bands
--	IC Ground	Ground	RF ground (exposed paddle)

Figure 3. Functional Block Diagram



Note: Package base is an exposed paddle conductor.

Electrical and Thermal Characteristics

Table 2. Absolute Maximum and Minimum Ratings

Parameter	Symbol	Min	Max	Units	Notes
Supply Voltage	Bias V_{CC}, LNA V_{CC}, DCS/PCS Out	--	3.6	volts	All modes
Digital Control Voltage	Power Down, Gain Control, Band Select	--	3.6	volts	All modes
Continuous Power Dissipation		--	22	mW	All modes
RF Input Level	GSM Input, DCS/PCS Input	--	+10	dBm	High gain mode
		--	+10	dBm	Low gain mode
Operating Temperature		-40	+85	°C	
Storage Temperature		-65	+150	°C	
Lead Temperature		--	240	°C	Soldering for 10 seconds

Table 3. DC Electrical Characteristics (-40 to +85 °C)

Parameter	Symbol	Min	Typ	Max	Units	Notes
Supply Voltage	V_{CC}	2.7	3.0	3.3	volts	
Supply Current	I_{CC}	--	5.1	7.0	mA	High gain mode
		--	2.6	3.5	mA	Low gain mode
		--	1.0	5.0	µA	Standby mode
Logic Input Low Voltage Level	V_{IL}	0.0	--	0.54	volts	
Logic Input High Voltage Level	V_{IH}	2.4	--	3.3	volts	
Logic Input Low Current	I_{IL}	--	--	-1.5	nA	V_{IL} = 0.0
Logic Input High Current	I_{IH}	--	--	1.5	nA	$V_{IH} = V_{CC}$

Table 4. Mode Control Truth Table

Mode	Control Pins		
	Band Select	Gain Control	Power Down
Standby	X	X	L
GSM Low Gain	L	L	H
GSM High Gain	L	H	H
DCS/PCS Low Gain	H	L	H
DCS/PCS High Gain	H	H	H

Note: X = Don't care.

Table 5. AC Electrical Characteristics, GSM900 Band

Parameter	Min	Typ	Max	Units	Notes
Power Gain	17.5	19.5	21.5	dB	High gain mode
	-6	-3	0	dB	Low gain mode
Gain Flatness (925 to 960 MHz)	--	+-0.3	--	dB	High gain mode
Noise Figure	--	1.4	1.9	dB	High gain mode
	--	5	7	dB	Low gain mode
Input Third Order Intercept Point (IIP3)	-6	-4	--	dBm	High gain mode
	-4	-1	--	dBm	Low gain mode
Input 1dB Compression	-22.5	-19.5	--	dBm	High gain mode
	-19.5	--	--	dBm	Low gain mode
Input Return Loss	10	12	--	dB	High gain mode
	9	11	--	dB	Low gain mode
Output Return Loss	11	14	--	dB	High gain mode
	6	8	--	dB	Low gain mode
Reverse Isolation	32	40	--	dB	High gain mode
	28	30	--	dB	Low gain mode

Note: Characteristics measured with IBM3604011EVBA Demonstration Board Assembly. Optimum external input matching and on-chip output matching to 50-ohm terminations. Input power = -30dBm (-21dBm: low gain mode); V_{CC} = 3.0 volts, ambient temperature = 25 °C, and frequency = 940 MHz. Max, Min and Typ values are based on statistical samples from several non-consecutive wafer lots.

Table 6. AC Electrical Characteristics, DCS1800 Band

Parameter	Min	Typ	Max	Units	Notes
Power Gain	16	17.5	19	dB	High gain mode
	-4	-1	2	dB	Low gain mode
Gain Flatness (1805 to 1880 MHz)	--	+-0.3	--	dB	High gain mode
Noise Figure	--	1.5	1.9	dB	High gain mode
	--	4.5	6.5	dB	Low gain mode
Input Third Order Intercept Point (IIP3)	-4	-1	--	dBm	High gain mode
	-2.0	+1	--	dBm	Low gain mode
Input 1dB Compression	-19.5	-17.5	--	dBm	High gain mode
	-17.5	--	--	dBm	Low gain mode
Input Return Loss	12	16	--	dB	High gain mode
	14	18	--	dB	Low gain mode
Output Return Loss	10	11	--	dB	High gain mode
	12	15	--	dB	Low gain mode
Reverse Isolation	30	34	--	dB	High gain mode
	26	28	--	dB	Low gain mode

Note: Characteristics measured with IBM3604011EVBA Demonstration Board Assembly. Optimum external input and output matching to 50-ohm terminations. Input power = -30dBm (-21dBm: low gain mode); V_{CC} = 3.0 volts, ambient temperature = 25 °C, and frequency = 1840 MHz. Max, Min and Typ values are based on statistical samples from several non-consecutive wafer lots.

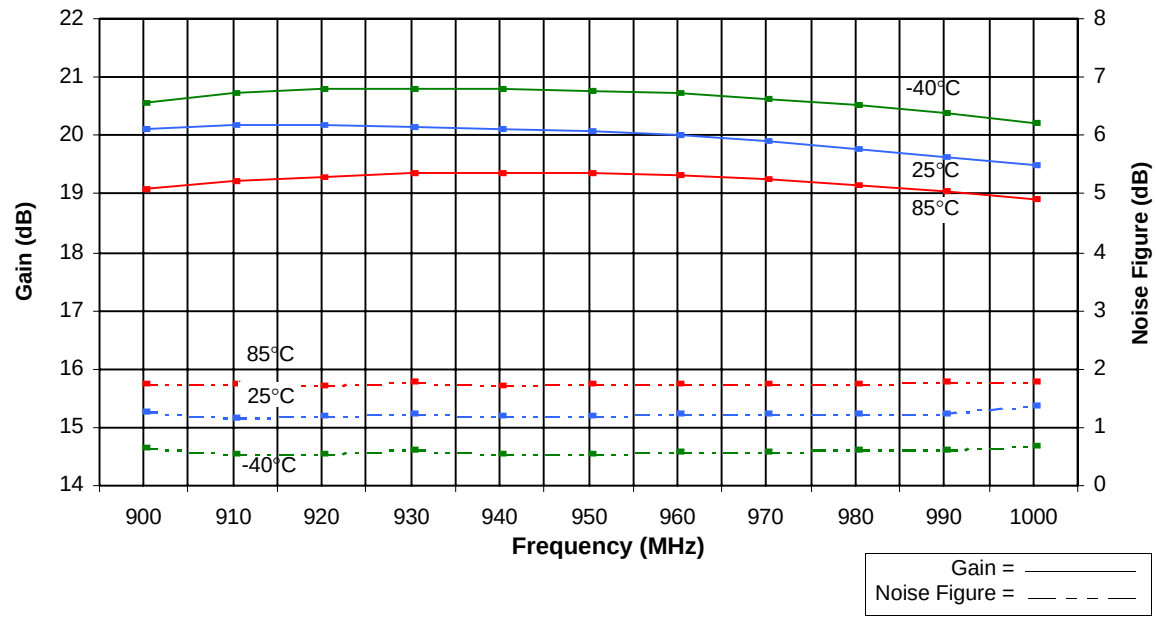
Table 7. AC Electrical Characteristics, PCS1900 Band

Parameter	Min	Typ	Max	Units	Notes
Power Gain	14.5	16	17.5	dB	High gain mode
	-5	-2	+1	dB	Low gain mode
Gain Flatness (1930 to 1990 MHz)	--	+-0.7	--	dB	High gain mode
Noise Figure	--	1.9	2.3	dB	High gain mode
	--	5	7	dB	Low gain mode
Input Third Order Intercept Point (IIP3)	-2	+1	--	dBm	High gain mode
	-1.5	+1.5	--	dBm	Low gain mode
Input 1dB Compression	-18	-16	--	dBm	High gain mode
	-16	--	--	dBm	Low gain mode
Input Return Loss	14	18	--	dB	High gain mode
	14	18	--	dB	Low gain mode
Output Return Loss	10	13	--	dB	High gain mode
	14	18	--	dB	Low gain mode
Reverse Isolation	34	37	--	dB	High gain mode
	25	27	--	dB	Low gain mode

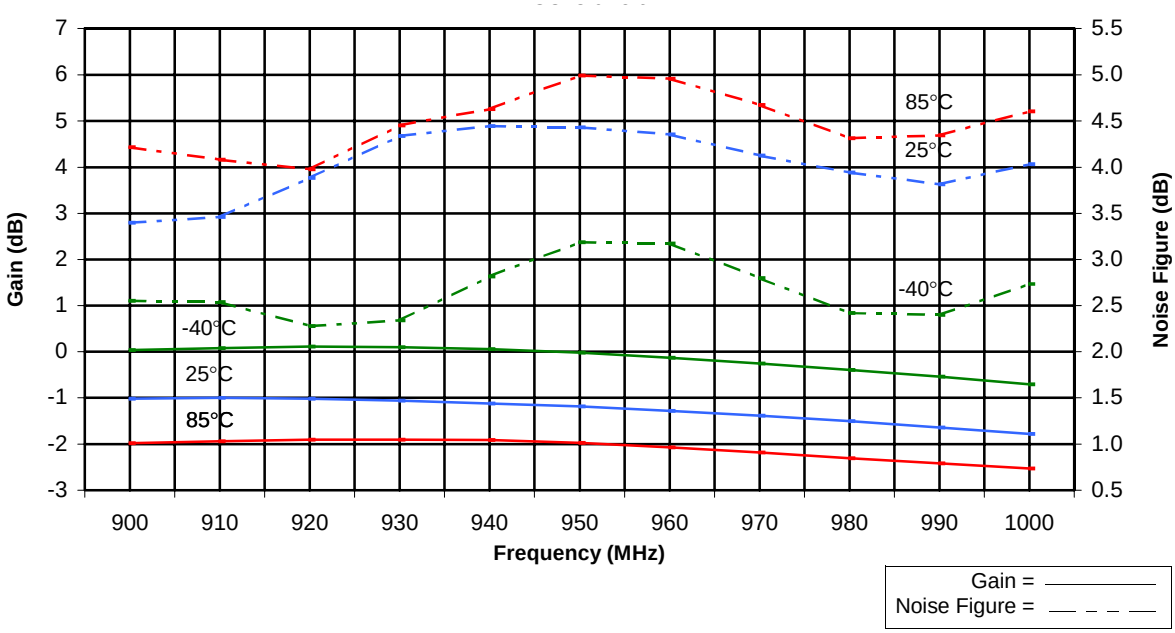
Note: Characteristics measured with IBM3604011EVBA Demonstration Board Assembly. Optimum external input and output matching to 50-ohm terminations. Input power = -30dBm (-21dBm: low gain mode); V_{CC} = 3.0 volts, ambient temperature = 25 °C, and frequency = 1960 MHz. Max, Min and Typ values are based on statistical samples from several non-consecutive wafer lots.

Gain and Noise Figure Plots (V_{CC} = 3.0V)

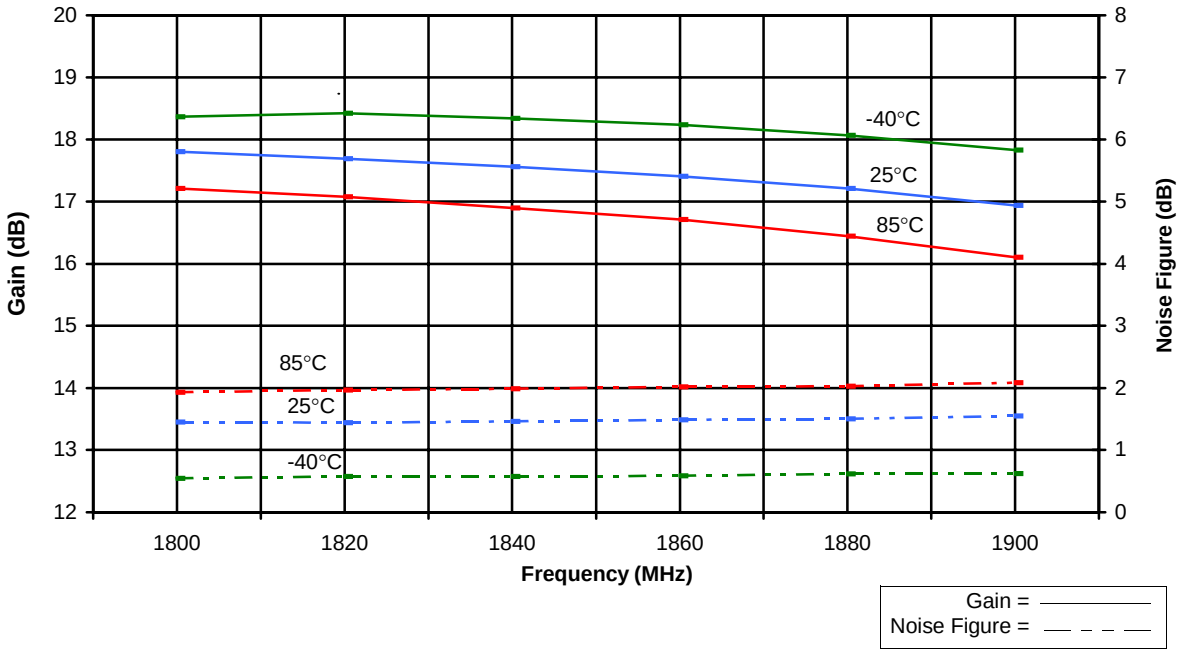
GSM900 Band, High Gain Mode



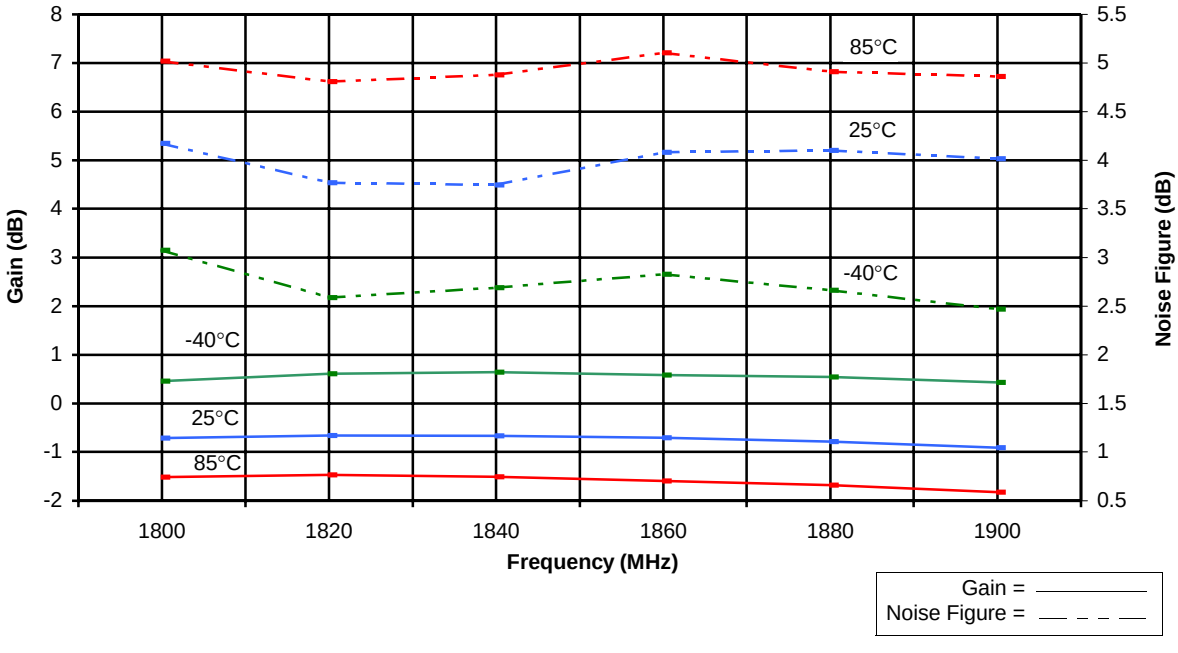
GSM900 Band, Low Gain Mode



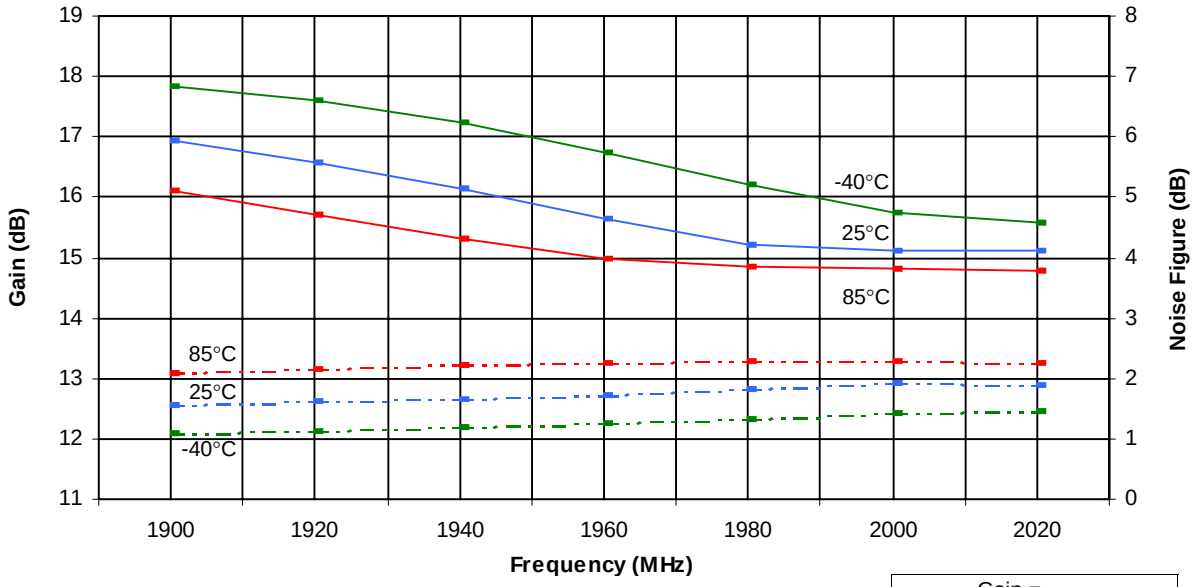
DCS1800 Band, High Gain Mode



DCS1800 Band, Low Gain Mode



PCS1900 Band, High Gain Mode



PCS1900 Band, Low Gain Mode

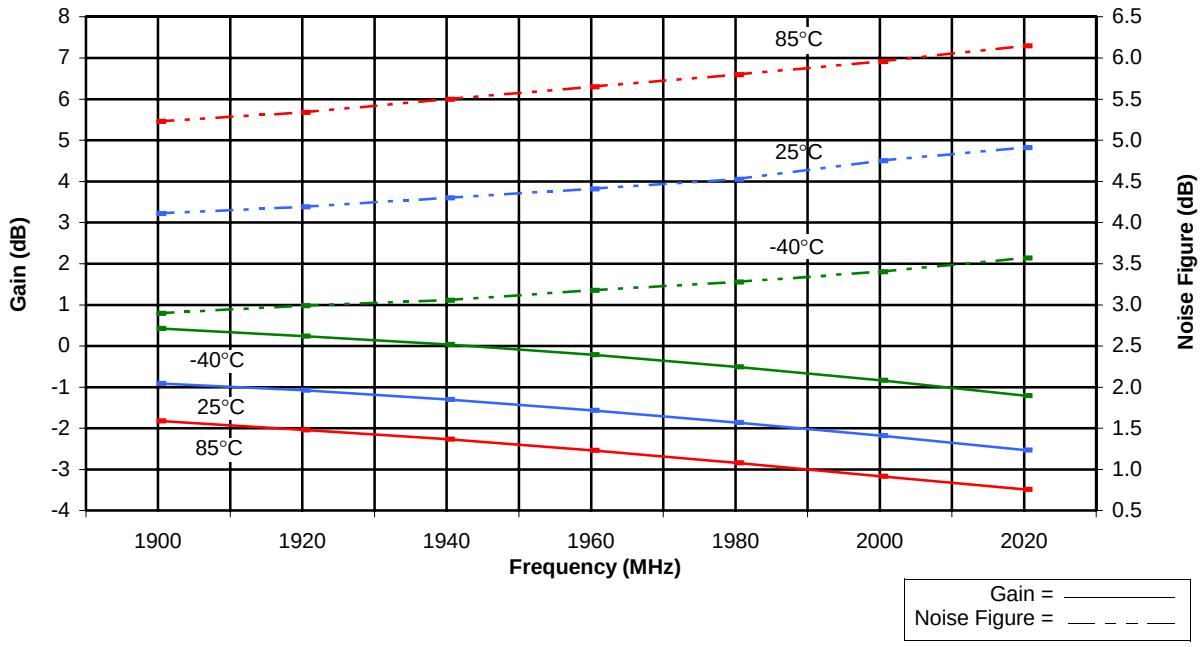
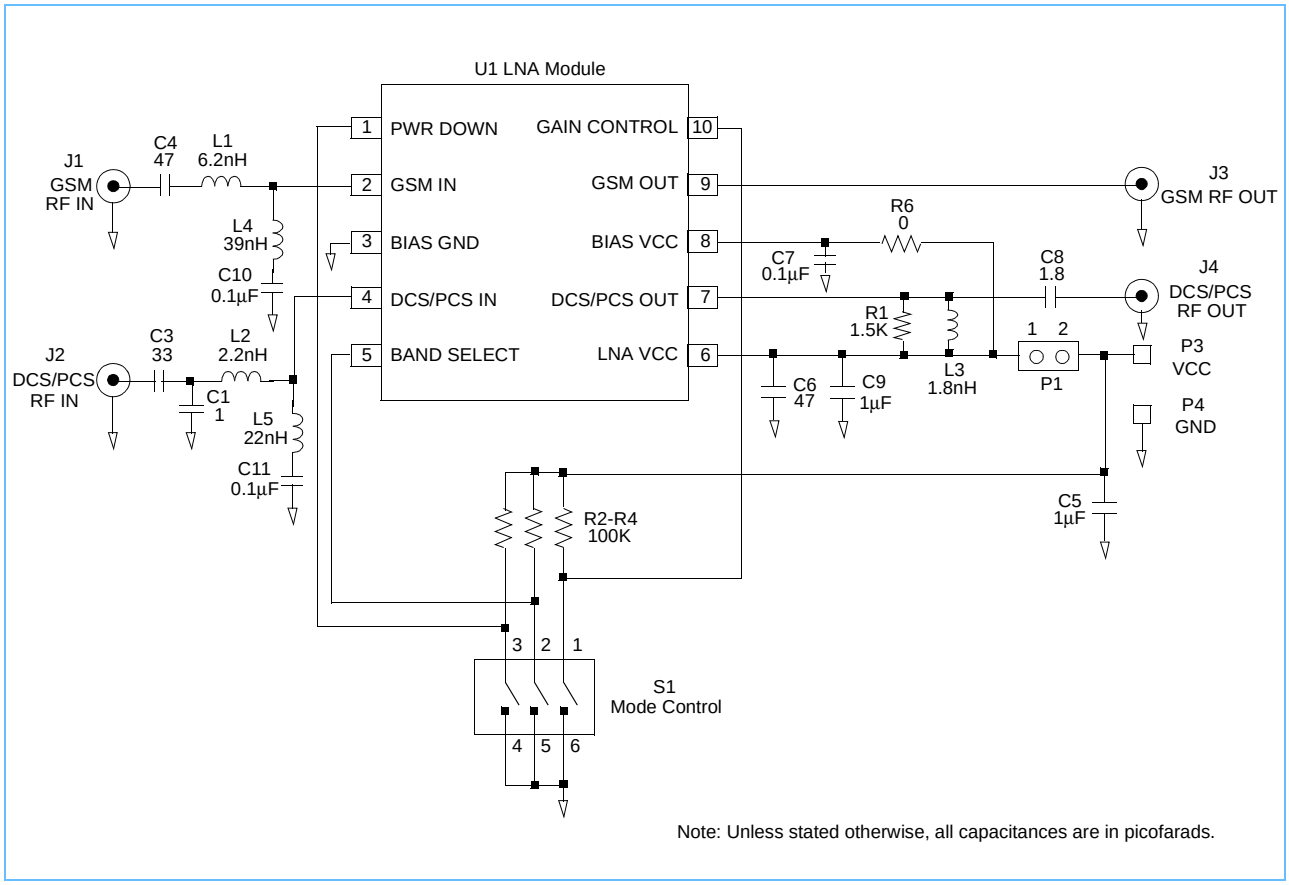


Figure 4. IBM3604011EVBA Demonstration Board Assembly Schematic



Mechanical Information

Figure 5. Package Diagram

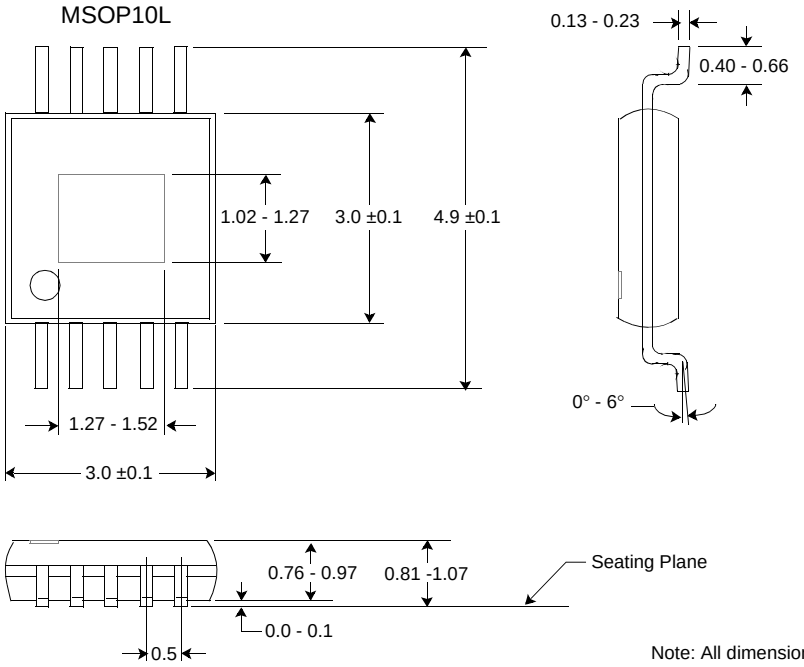
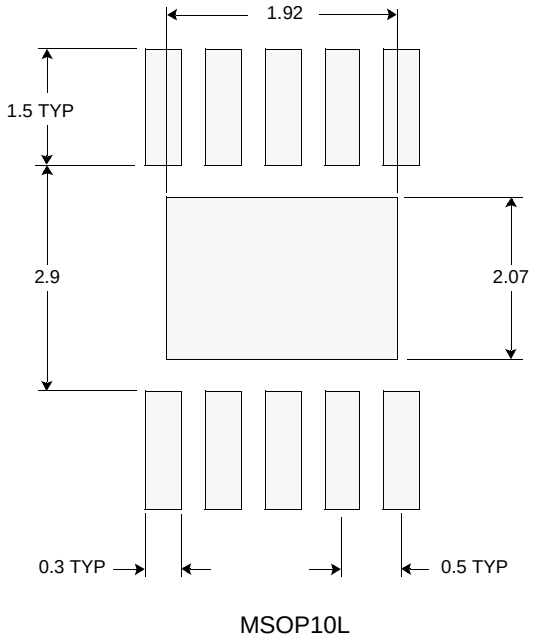


Figure 6. PCB Pad Placement



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Rev.	Contents of Modification
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October 3, 2001	First revision (01). Preliminary removed

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